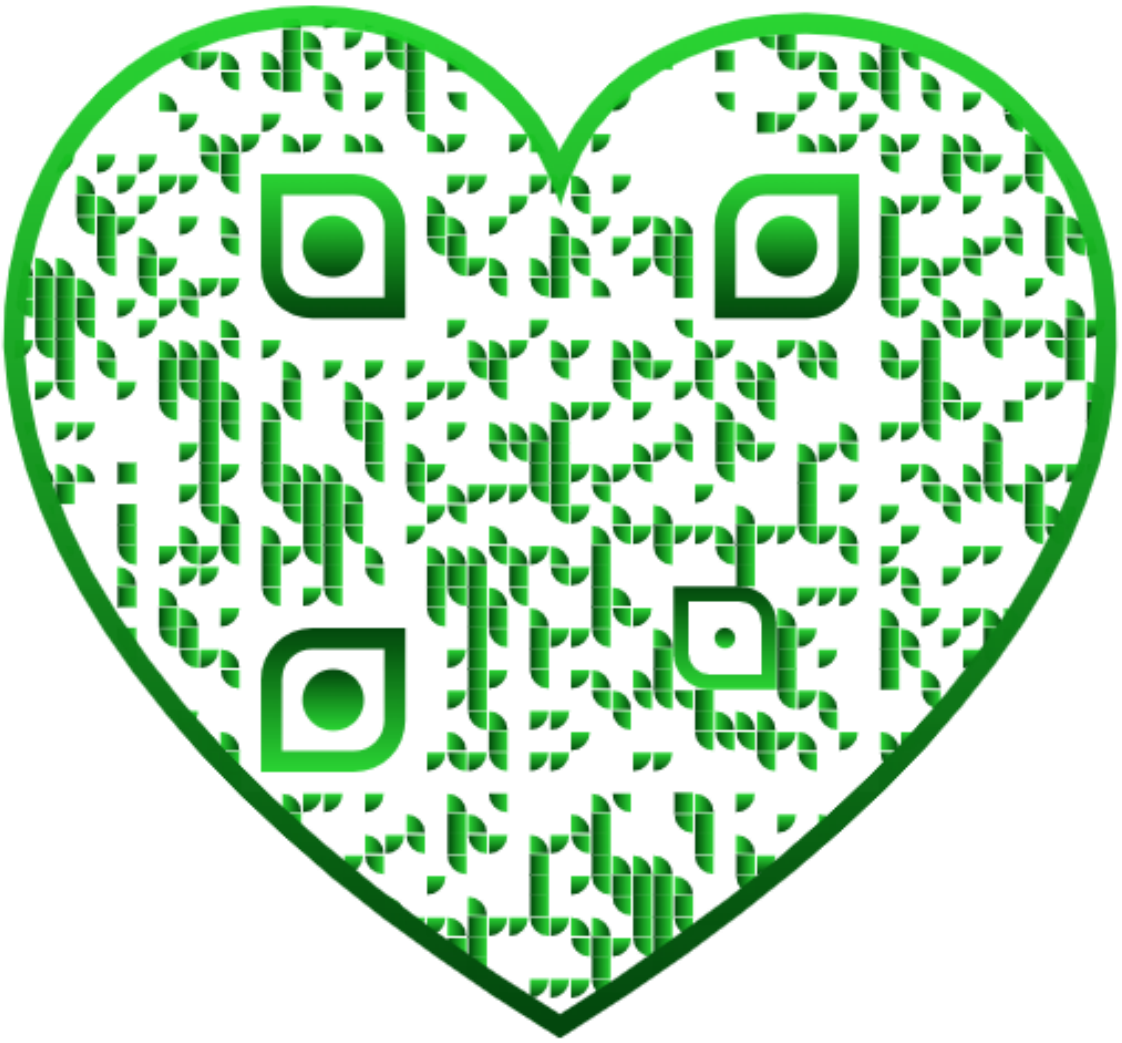
CHAPTER FOUR

COSTS AND TIME PREFERENCE



Learning objectives

Upon completion of this chapter, you should be able to:

- Identify costs and cost of illness
- Understand measurement of costs
- Identify time preference and measuring preference
- Understand discounting and discounting rate
- Identify amortization and annuity

Outline

- Definitions
- Measures of cost
- Types of costs
- Use of cost data
- Cost of Illness and Cost of Therapy
- Time preference
- Types of Intervention Cost Studies
- Annuitizing Capital Expenditures
- Adjusting for Inflation

Definition

What is Cost?

- A cost is the **value of resources** used to produce a good or service. the resources can be labor, buildings, equipment, supplies, etc.
- Production in the health care sense:
- Therapies that cure, prevent, or alleviate disease

What is cost unit?

- A cost unit is “a unit of product, service or time in relation to which cost may be ascertained or expressed.”

What is Cost Analysis?

Cost analysis is a study that considers one or more alternatives, and only costs are examined. It **Has two categories**

- Full cost analysis
- Incremental cost analysis

- **Full cost analysis:** Estimates costs of all resources that are being employed in running a programme or a project, including basic infrastructure
- **Incremental cost analysis:** Accounts for the major 'new' inputs that are required by the new intervention

Measurement of costs

- Two alternatives in measurement of resources used to produce goods and services:
  - Financial/Accounting costs
  - Economic/opportunity costs

Financial/Accounting costs

- Actual expenditure on goods & services purchased

Economic/opportunity costs

- Costs in terms of alternative uses that have been foregone by using resource in a particular way
- Include values of goods or services for which there is **no financial transaction**
- **Ex. volunteer time, donated materials, donated space, etc.**

Types of costs

- **Direct medical cost:** E.g. cost of medicines used, consultation fees paid, medication and administration
- **Direct non-medical** – e.g., transportation for treatment
- **Indirect cost**: E.g. rent, depreciation
- **Intangible costs:** E.g. pain ,anxiety, isolation, depression

Direct Medical Costs

Costs associated with those resources used specifically for medical t/t. further categorized into two:

- **Direct MEDICAL costs:** direct costs - are costs that are directly attributable to patient care. drugs, home nursing, diagnostic tests, medication administration, medication monitoring, patient counseling and consultations (physician and pharmacists visits), nursing services and lab tests and hospitalizations, etc.
- **Direct non-MEDICAL costs:** Food, transportation, caregiver expenses, food and hotel stays for patient or family during out-of-town t/t, special diets, etc.

  Direct Costs = direct medical costs+ direct non medical costs

Indirect costs

Indirect costs: refer to loss of productivity because of illness or death or as results of time spent receiving t/t.

- costs resulting from a patient being unable to perform normal activities due to illness and therefore borne by either the patient, the patient's family, or an employer
- indirect costs are non-medical costs, measured by lost wages, willingness to pay, or human capital theory.
- Indirect Cost=morbidity costs + Mortality Costs

Indirect cost..

Morbidity costs can be:

– absenteeism (when people miss work)

– presenteeism (when people are less productive while at work)

Mortality costs represent the incomes lost as a result of premature death

Indirect costs = morbidity costs + mortality costs

• Examples of indirect costs: – reduced levels of output/decreased productivity, lost earnings.•because of illness, side effects, or time spent receiving t/t, caring for a sick family member. – future wages lost because of a premature death

Friction costs: the total direct and indirect costs associated with the execution of a financial transaction.

Intangible cost

- are those emotional costs such as costs of pain, suffering, anxiety and fatigue which a patient or their family might suffer because of an illness or the treatment of an illness
  - are the nonmaterial costs
  - intangible costs are often not included in cost analyses, because – it is difficult to measure or place a monetary value on these types of costs
- Examples of intangible costs:
  - disfigurement (e.g. breast cancer with surgery)
  - functional limitations (e.g. paralysis from polio)
  - pain and suffering (e.g. rheumatoid arthritis or bone metastasis)
  - fear (HIV, rabies)

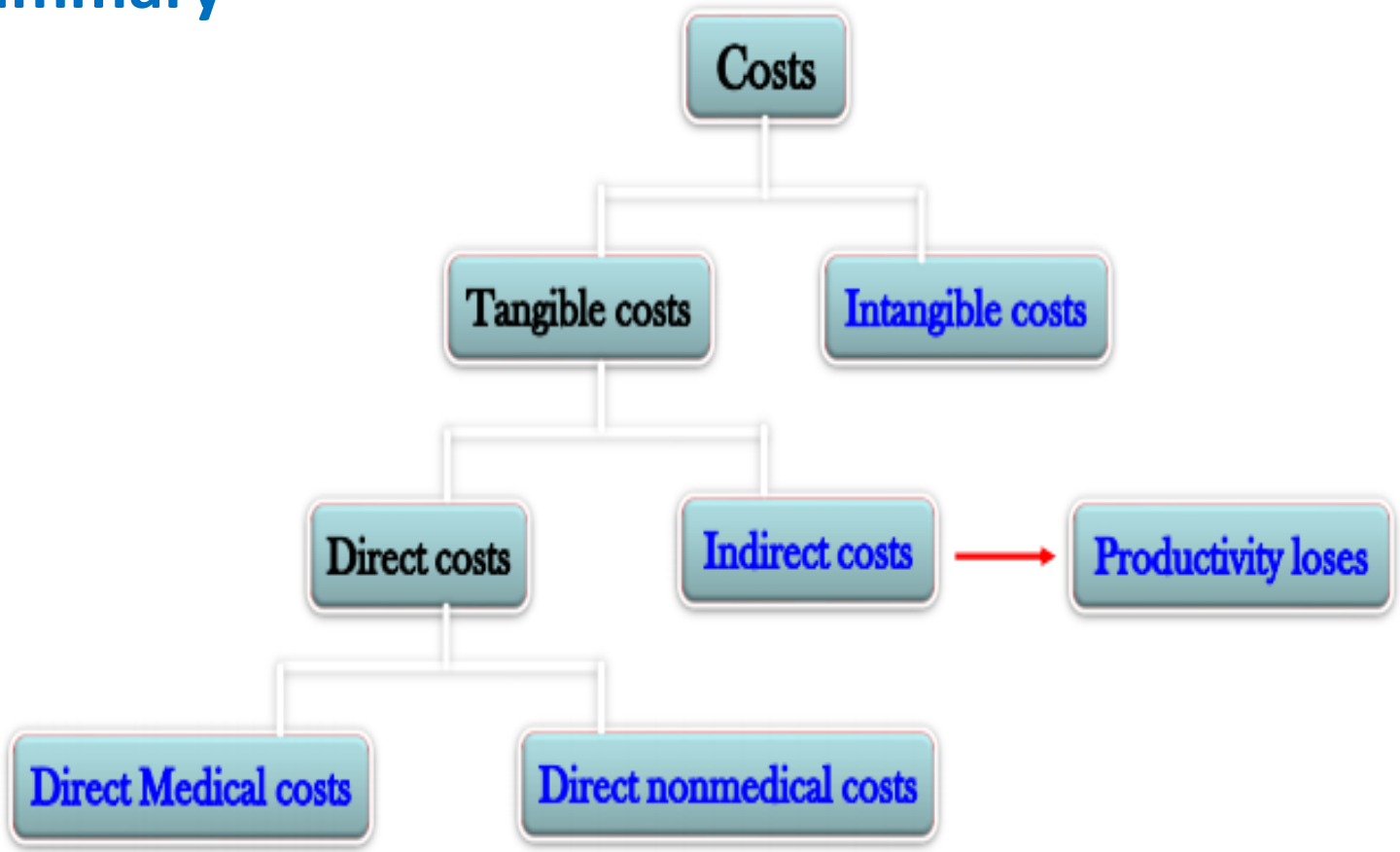
Example – identifying costs

A pharmacist running a private community pharmacy has suffered from renal failure. He visits a hospital 3 times a week for dialysis. Cost of one dialysis is 1,500 Eth birr. He uses his own automobile to travel to the hospital. His productivity has decreased because of repeated absenteeism for dialysis, fatigue and headache. His average monthly income has fallen from 40,000 birr to 30,000 birr.

a. What are the direct medical, direct nonmedical, indirect and intangible costs incurred by the pharmacist?

b. If he dies, what type of costs will be incurred by his family? and how much?

Summary



Total costs = direct medical costs + direct nonmedical costs + indirect costs + intangible costs

Terms related to Costs

Total cost [TC]: Represents the cost of producing a quantity of services or goods for a particular project & program

- It is a measure of the aggregate resource requirements of a particular scale of activity & is derived by summing all costs incurred during production. E.g. Screening mammography costs

Average cost [AC]:

- A measure of the **total costs** of production associated with **each unit** of output
- Indicate the resource requirements for each unit of out put and are calculated by dividing total costs [TC] by the number of outputs [Q]. AC = TC/Q
- E.G. The cost per mammograms provided

Marginal cost [MC] : A measure of the resources associated with a **small incremental change in output.** The additional cost of producing one more unit Or the reduction in cost from producing one unit less

- MC=TC (at Q+1)-TC (at Q)
- E.g. cost of adding one more mammogram

Terms…

- **Fixed costs (FC):** Refer to the costs that are necessarily incurred in setting up a productive activity. **Often known as overheads**
  - Born irrespective of how much output is produced
  - Usually defined in relation to the time period under consideration [financial year]
- **Variable costs [VC]:** Those costs that are **directly related** to how much out put is produced:

  VC=TC- FC
  - VC is the extra cost of producing Q, above the cost of producing 0. In the "long run," all costs are variable
- **Capital costs**
  - Usually defined as costs for items with a life of **more than one year**
  - Examples construction of buildings, purchase of equipment, basic man power training
  - Major capital items will fall in to the category of **fixed costs**

Terms…

- **Recurrent costs**
  - Costs that are necessary incurred each year
  - They include: Salaries and wages, Supplies [drugs, petrol], Electricity, water, In- service training
- **Social cost**
  - Include indirect expenditures for health effects such as the total value of lost production or cost of social support for a person whose health & work capacity has been impaired by illness
- **Joint costs**
  - Costs used by more than one projects or programmes of an organization, therefore have to be allocated to the projects
- **Private cost**
  - Include out of pocket expenditures that an individual makes to purchase health care plus related expenses such as payments for health insurance, loss of wages
  - Purchase of medicines, co- payments for health services etc

Uses of Cost Data

- Accountability
- Assessing efficiency
- Assessing equity
- Assessing priority
- Making cost projection
- Considering cost recovery

Cost of Illness and Cost of Therapy

- **Cost of illness is the sum of:**
  - The **medical resources** used to treat the illness:
    - Hospital care, Professional services, Drugs & supplies
  - **Non-medical resources:** Expenditure outside the medical care, Transportation
  - **Lost productivity:** Lost wages, Absenteeism, Presenteeism
  - Intangible **costs of pain** and **anxiety**

Types of Intervention Cost Studies

- **Retrospective**
  - Attempts to identify the program costs after the program has begun or been completed
- **Prospective**
  - Cost data collected while the intervention program is in effect

Quantification of Cost

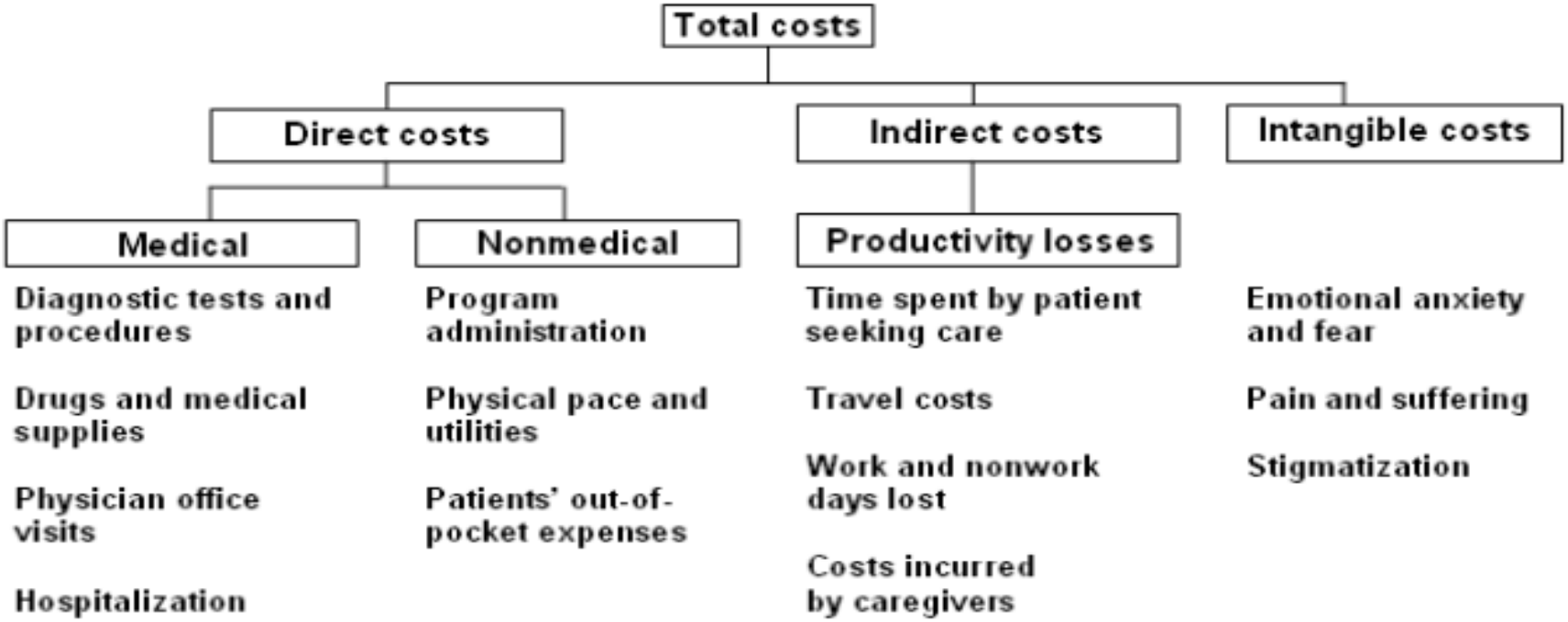
Costing process involves four steps:

1. Specifying the inputs --- identify resources used
2. Measuring resources used
3. Value the resources used: assigning monetary value
4. Adjusting for time preferences

1. Specifying the inputs

- Develop comprehensive list of all relevant inputs
- list will be determined by the perspective of the analysis.
- perspectives determine which costs are relevant and should be included in the analysis

Example: List of resources



2. Measuring the quantity of resources used

- Having developed the list of resources, we can measure the quantity of each resource used in the delivery of the intervention
  - What quantity of each resource is needed?
  - Determine how many units is consumed over the study period
  – count the number of units that are consumed over time
  – determine hours or days lost

3. Valuing the resources used : assigning monetary value

- How much does each resource cost in monetary terms?
- Direct costs such as costs of drugs, equipment, supplies, counseling and consultation times can be valued as follows: Direct cost = Quantity of resources consumed X unit cost … this is relatively simple for consumable items.
- Indirect costs (productivity costs) such as, time off work for the patient and time off work for family and friends can be valued as follows:
  – determine hours or days lost
  – then multiply this with average wage rates (or actual wage rates)
  Indirect cost = hours or days lost x hourly or daily wage rate
  Common sources of cost data include:
  – primary data collection
  – secondary data sources:
  •medical or computerized records
  •average medical personnel wages

4. Timing adjustments for costs

- A cost or outcome today is not equivalent in value to the same cost or outcome in the future or past.
- Direct comparison of unadjusted cost and outcome data which are collected from different years is inaccurate
- To make costs and outcomes collected in different years comparable, they should be standardized to the same base year. – timing adjustments for costs
- when costs are estimated from different years for more than one year before or after the analysis, the costs should be adjusted, or valued at one point in time
- There are three types of timing adjustment for costs:
  – discounting future costs
  – standardization of past costs
  – annuitizing capital expenditures

Time Value of Money

- We say that money has a time value b/c that money can be invested with the expectation of earning a positive rate of return
- In other words, “a dollar received today is worth more than a dollar to be received tomorrow”
- That is b/c today’s dollar can be invested so that we have more than one dollar tomorrow

- The future value calculation is based on the concept of the time value of money.
- This simply means a dollar earned today is worth more than a dollar earned tomorrow because funds you control now can be invested and earn interest over time.
- Therefore, the future value of an annuity is greater than the sum of all your investments because those contributions have been earning interest over time.

Time Preference…

- For example, the future value of $1,000 invested today at 10% interest is $1,100 one year from now.
- A single dollar today is worth $1.10 in a year because of the time value of money.
- Would you prefer to have $100 now or in the future?
- Positive rate of time preference
- Why?
  - ‘Live now, pay later’ attitude
  - Future is uncertain
  - Might expect to be wealthier in the future – e.g., after graduation!

Time Preference…

- **Present Value** - An amount of money today, or the current value of a future cash flow
- **Future Value** - An amount of money at some future time period
- **Period** - A length of time (often a year, but can be a month, week, day, hour, etc.)
- **Interest Rate** - The compensation paid to a lender (or saver) for the use of funds **expressed as a percentage for a period** (normally expressed as an **annual rate**)

Discounting Cost

- Discounting is the process of converting a value received in a future time period (e.g., 1, 10, or even 100 years from now) to an equivalent value received immediately.
  - For example, a dollar received 50 years from now may be valued less than a dollar received today—discounting measures this relative value
- Discounting is the process of converting future costs to their present value.
- There are two approaches for discounting future costs depending on whether all the costs occur at the end of each year or at the beginning of each year

Discount cont'd…

- Why Discount? Discounting is used to measure the difference between present values and future values.
- When a car is on sale for 10% off, it represents a discount to the price of the car.
- The same concept of discounting is used to value and price financial assets.
- The difference in value between the future and the present is created by discounting the future back to the present using a discount factor, which is a function of time and interest rates.

Discounting and Risk

- In general, a higher the discount means that there is a greater the level of risk associated with an investment and its future cash flows.
- Discounting is the primary factor used in pricing a stream of tomorrow's cash flows.
- For example, the cash flows of company earnings are discounted back at the cost of capital in the discounted cash flows model.
- In other words, future cash flows are discounted back at a rate equal to the cost of obtaining the funds required to finance the cash flows.
- A higher interest rate paid on debt also equates with a higher level of risk, which generates a higher discount and lowers the present value of the stocks.

Discounting

- Discounting is the process of determining the present value of a payment or a stream of payments that is to be received in the future.
- Given the time value of money, a dollar is worth more today than it would be worth tomorrow.
- Discounting is the primary factor used in pricing a stream of tomorrow's cash flows.
- A bird in the hand is worth two in the bush!
- Discounting is Method used to compare costs & benefits that occur at different times. **Formula for Computing Present Value:**

$$P = \sum_{n=1} F_n (1 + r)^{-n}$$

- Where: P = present value; Fn = future cost at year n; and r = annual interest (discount) rate, e.g., 5%

Discounting

- Or It can expressed as: …
- Reciprocal of Compounding
- Discounting is the present Value (PV) of future value received in time period t.

$$PV = FVt/(1+r)^t$$

- It is the amount of money needed to invest today to obtain FV_t in time t
- Discounting Factor

$(1/(1+r)^t)$

Exercise

If you invest $100 today, what would be the value of your dollar three years from now with 8% interest rate?

Solution:

- Given: PV = $100, r=8%, t=3 years
- Calculate: FV
- Solution:
  - $FVt = PV * (1+r)^t$
  - $FVt = 100 * (1+0.08)^3$
- **Answer FV= $125.97**

How Do We Discount?

- $P = \sum Fn\ (1+r)^{-n}$
  - P = present value
  - Fn = future cost at year n
  - r = discount rate

Year	Costs prog A (Br.)	Costs prog B (Br.)
1	5	15
2	10	10
3	15	4
Total	***30***	***29***
Discounted	***26.79***	***26.81***

How Do We Discount?

Programme A: Using equation (r=0.05)

$P = F1/(1+r) + F2/(1+r)^2 + F3/(1+r)^3$

$P = 5/(1+0.05) + 10/(1+0.05)^2 + 15/(1+0.05)^3$

$P = 26.79$

Programme B: Using equation

$P = F1/(1+r) + F2/(1+r)^2 + F3/(1+r)^3$

$P = 15/(1+0.05) + 10/(1+0.05)^2 + 4/(1+0.05)^3$

$P = 26.81$

Example : The costs of cancer t/t for the next 3 years are $5,000 for year 1, $3,000 for year 2, and $4,000 for year 3. Determine total costs in PV terms using 5% discount rate.

a.assuming that all the costs occur at the end of each year.

b.assuming that all the costs occur at the beginning of each year.

A. assuming that all the costs occur at the end of each year.

$$PV = F_1 \times df_1 + F_2 \times df_2 + F_3 \times df_3$$

$$= \$5{,}000(0.9524) + \$3{,}000(0.9070) + \$4{,}000(0.8638)$$

$$= \$4{,}762 + \$2{,}721 + \$3{,}455 = \underline{\$10{,}938}$$

Year Costs Are Incurred	Future Costs ($)	Present value ($)
Year 1	5,000	4,762
Year 2	3,000	2,721
Year 3	4,000	3,455
Total	12,000	10,938

B. assuming that all the costs occur at the beginning of each year

- $PV = F_1 + F_2 \times df_1 + F_3 \times df_2$
  - =$5,000+ $3,000(0.9524) +$4,000(0.9070)
  - =$5,000+ $2,857+ $3,628 =$11,485

Year Costs Are Incurred	Future Costs ($)	Present value ($)
Year 1	5,000	5,000
Year 2	3,000	2,857
Year 3	4,000	$3,628
Total	12,000	$11,485

- Future health is often considered to be less valuable than immediate health
- This has important implications because the utility of an outcome often depends on when it occurs. For example, a stroke that occurs immediately may have a different impact on the patient than one that occurs ten years later
- For economic analyses, both costs and outcomes are discounted at the same discount rate

- Example 2: A decision maker has funds of approximately $146,000 to implement a preventive programme. Suppose a 5 year program has been proposed with the following expected costs and health outcomes.

Year	Cost	outcomes
1	$20,000	2 LY
2	$30,000	4 LY
3	$50,000	10 LY
4	$35,000	15 LY
5	$30,000	20 LY

- If all the costs occur at the end of each year, is the budget at hand enough to cover the proposed programme under a discount rate of 5%?

Three Methods of Payment

Loan payments can be structured in one of 3 ways:

1. **Discount loan:** Principal and interest is paid in lump sum at end
2. **Interest-only loan:** Periodic interest-only payments, principal due at end.
3. **Amortized loan**: Equal periodic payments of principal and interest. Amortization is the process of reducing a cost or total in regular small amounts.

As we shall see, interest rates are calculated on a **reducing balance method.** With a reducing balance method, interest is calculated on the principal amount outstanding, after the principal element contained in the previous period's repayment has been deducted.

Payment Methods: Discount Loan…

Example: Discount versus Interest-only versus Amortized loans

A person wants to borrow $40,000 for a period of 5 years. lenders offers to person a choice of three payment structures:

- Pay all of the interest (10% per year) and principal in one lump sum at the end of 5 years;
- Pay interest at the rate of 10% per yr for 4 yrs and then a final payment of interest and principal at the end of the 5^{th} yr;
- Pay 5 equal payments at the end of each year inclusive of interest and part of the principal.

Under which of the three options will a person pay the least interest

and why? Calculate the total amount of the payments and the amount of interest paid.

Payment Methods….Discount loan

Method 1: Discount Loan: Since all the interest and the principal is paid at the end of 5 years we can use the FV of a lump sum equation to calculate the payment required, i.e.

$$FV = PV \times (1 + r)^n$$

$$FV_5 = \$40{,}000 \times (1+0.10)^5$$

$$= \$40{,}000 \times 1.61051$$

$$= \$64,\ 420.40$$

Interest paid = Total payment - Loan amount

Interest paid = \$64,420.40 - \$40,000 = \$24,420.40

Payment Methods: Interest-Only Loan

Method 2: Interest-Only Loan. Annual Interest Payment (Years 1-4)

= $40,000 x 0.10 = $4,000 each year ($16,000)

Total Payment=$16,000+4,000+40,000 = $60,000

Method 3: Pay 5 equal payments .Year 5 payment

= Annual interest payment + Principal payment

= $4,000 + $40,000 = $44,000

Total payment = $16,000 + $44,000 = $60,000

Interest paid = $60,000 - $40,000 = $20,000

Payment Methods: Amortization

- Amortization is paying off a debt over time in equal installments.
  - Part of each payment goes toward the loan principal, and
  - part goes toward interest.
  - With mortgage loan amortization, the amount going toward principal starts out small, and gradually grows larger month by month. Meanwhile, the amount going toward interest declines month by month for fixed-rate loans.

Payment Methods: Amortization…

- Example: You 30-year mortgage for $240,000 at a 5% interest rate that carries a monthly payment of $1,288.
  - In month one: $240,000*5% = $12,000. Divide that by 12, and you have $1,000 in interest for your first monthly payment.
  - The remaining $288 goes toward paying down principal.
  - For month two, outstanding principal balance is $240,000 minus $288, or $239,712. Multiply that by 5% and divide by 12, and you get a slightly smaller amount -- $998.80 -- going toward interest.
  - Gradually over the ensuing months, less money will go toward interest, and your principal balance will get whittled down faster and faster. By month 360, you owe just $5 in interest, and the remaining $1,283 pays off the balance in full.

Annuity

- An annuity is an amount of money paid to someone at some regular interval.
- An annuity is any sequence of equal periodic payments.
- Most people think in terms of annuity products: an agreement or contract for one person or organisation to pay another (the annuitant) a stream or series of payments (annuity payments).

Types of Annuity

BASIS FOR COMPARISON	ORDINARY ANNUITY	ANNUITY DUE
Meaning	Ordinary annuity is one in which the inflow or outflow of cash fall due for payment **at the end of each period.**	Annuity due is described as the series of cash flows occurring at the **beginning of each period**.
Payment	Belongs to the period preceding its date.	Belongs to the period following its date.
Appropriate for	Payments	Receipts
Example	Housing loan, payment of mortgage, coupon bearing bonds, etc.	Rental lease payments, life insurance premium, etc.

Ordinary Annuities

Calculating the Future Value

- If you know how much you can invest per period for a certain time period, the future value (FV) of an ordinary annuity formula is useful for finding out how much you would have in the future.
- If you are making payments on a loan, the future value is useful in determining the total cost of the loan.
- If you know how much you plan to invest each year and the fixed rate of return your annuity guarantees—or, for loans, the amount of your payments and the given interest rate—you can easily determine the value of your account at any point in the future.

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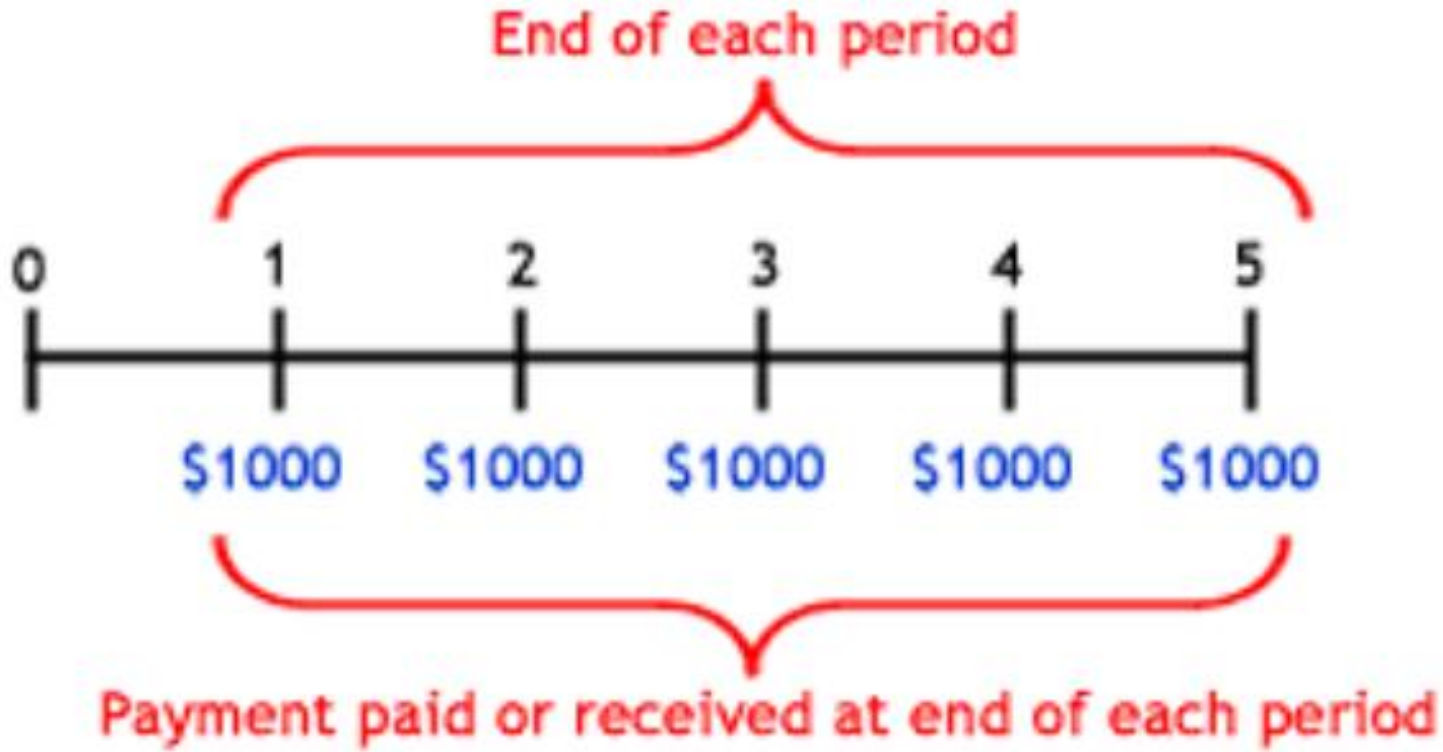

End of each period
0
1
2
3
4
5
$1000
$1000
$1000
$1000
$1000
Payment paid or received at end of each period

Present Value

- The PV of an annuity is simply the current value of all the income generated by that investment in the future.
- This calculation is predicated on the concept of the time value of money, which states that a money now is worth more than the one earned in the future.
- Present value calculations use the number of time periods over which income is generated to discount the value of future payments.

PV…

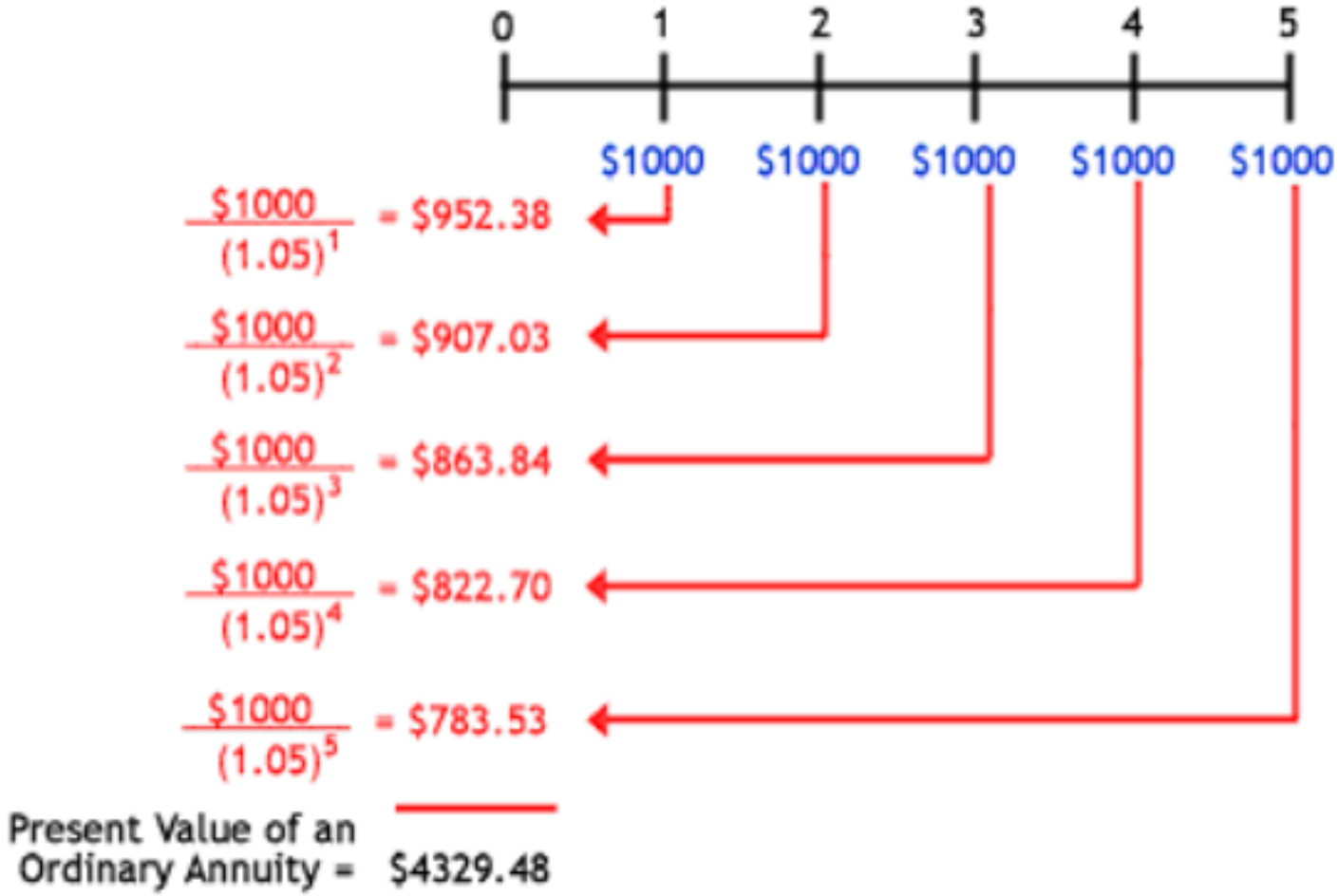
- If you would like to determine today's value of a future payment series, you need to use the formula that calculates the present value of ordinary annuity.
- The PV of an ordinary annuity calculates the present value of the payments that you will receive in the future.
- The present value is the reciprocal of the future value.

- The present value of annuity is the reciprocal of the future value of annuity.
- Many financial products in the financial services market, such as pension plans, income bonds and insurance policies, health sectors all involve, in one fashion or another, the determination of the present value of an annuity.

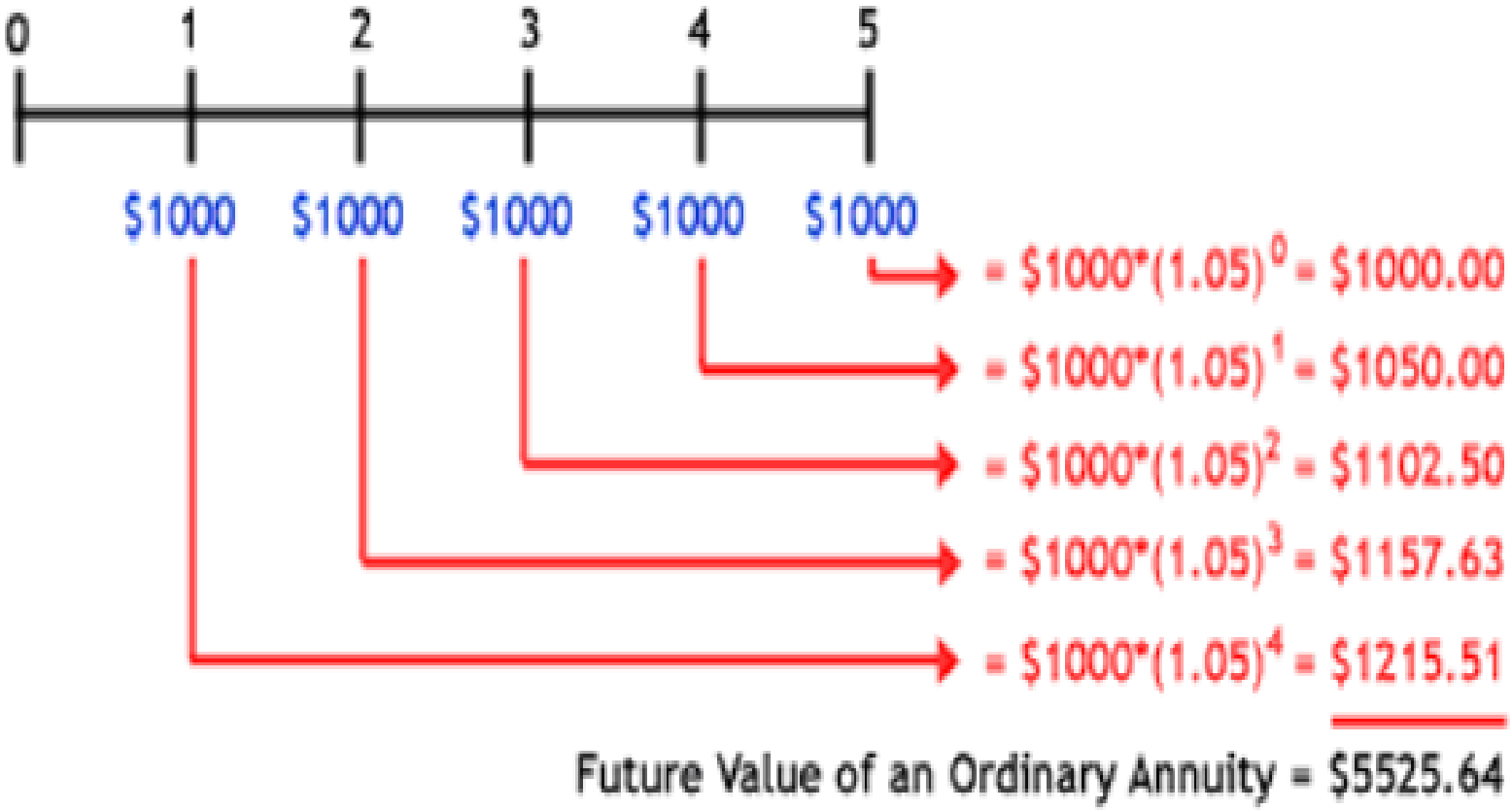
Example

- **Examples of annuities** are regular deposits to a savings account, monthly home mortgage **payments**, monthly insurance **payments** and pension **payments**.
- Example – calculations, Let us assume that you are receiving $1,000 every year for the next five years and you invest each payment at 5% interest. The following diagram shows how much you would have at the end of the five-year period:

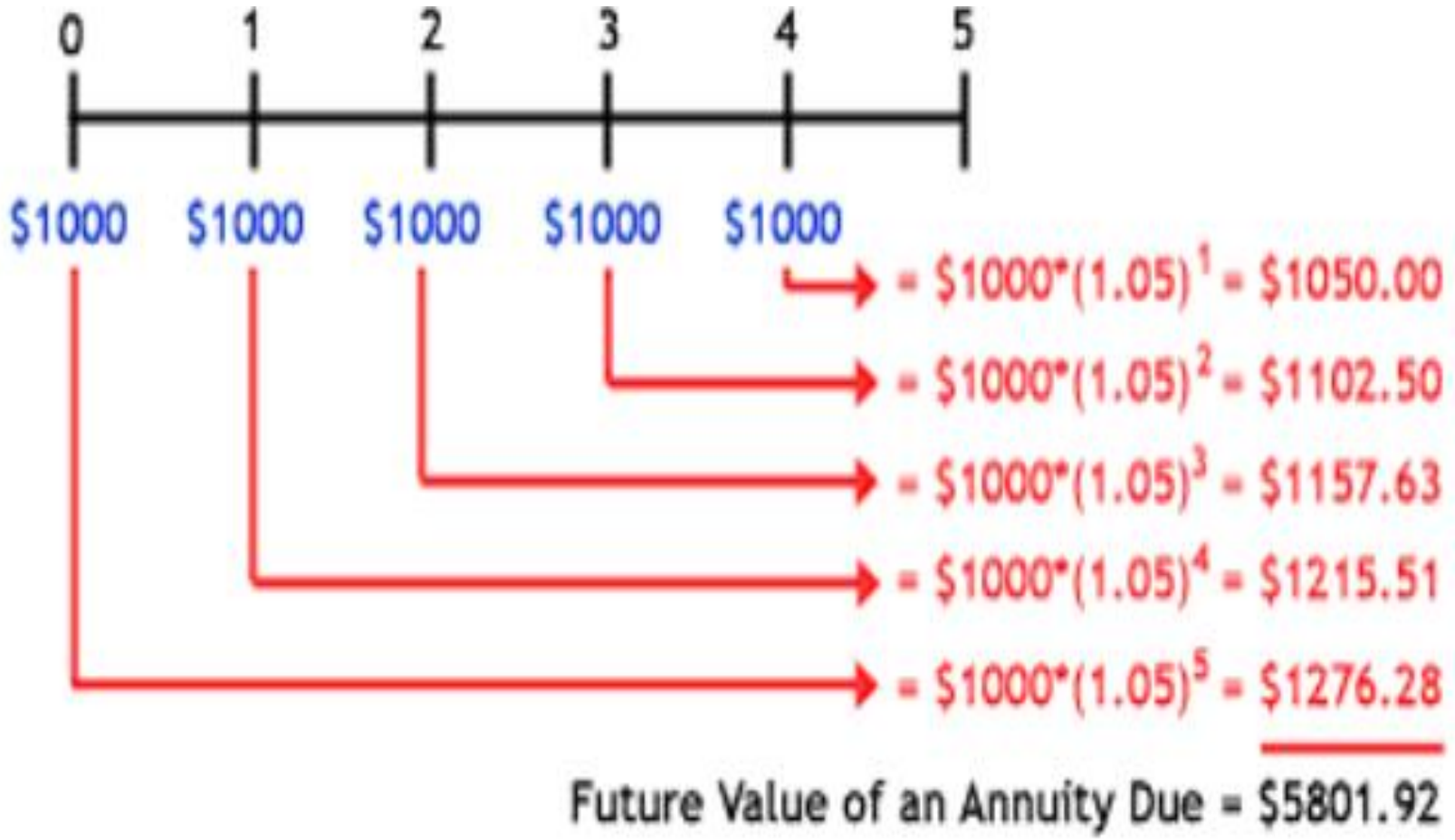
Present value



Ordinary Annuity



Annuity Due (future value)



Cont..

$$\mathrm{PV}_{\text{Ordinary Annuity}} = \mathrm{C} \times \left[\frac{1-(1+i)^{-n}}{i}\right]$$

The formula provides us with the PV in a few easy steps. Here is the calculation of the annuity represented in the diagram for Example 2:

$$\begin{aligned}\mathrm{PV}_{\text{Ordinary Annuity}} &= \$1000 \times \left[\frac{1-(1+0.05)^{-5}}{0.05}\right] \\ &= \$1000 \times [4.33] \\ &= \$4329.48\end{aligned}$$

Formula for ordinary annuity and Present Value

$$\text{FV}_{\text{Ordinary Annuity}} = \text{C} \times \left[\frac{(1+i)^n - 1}{i} \right]$$

where:

$\text{C} = \text{Cash flow per period}$

$i = \text{Interest rate}$

$n = \text{Number of payments}$

Using the above formula for Example 1 above, this is the result:

$$\begin{aligned} \text{FV}_{\text{Ordinary Annuity}} &= \$1000 \times \left[\frac{(1+0.05)^5 - 1}{0.05} \right] \\ &= \$1000 \times [5.53] \\ &= \$5525.63 \end{aligned}$$

Formula of Future value Annuity Due

$$FV_{\text{Annuity Due}} = C \times \left[\frac{(1+i)^n - 1}{i}\right] \times (1+i)$$

Therefore,

$$\begin{aligned} FV_{\text{Annuity Due}} &= \$1000 \times \left[\frac{(1+0.05)^5 - 1}{0.05}\right] \times (1+0.05) \\ &= \$1000 \times 5.53 \times 1.05 \\ &= \$5801.91 \end{aligned}$$

Inflation

Inflation is rising general level of prices and it reduces the "purchasing power" of money

Inflation—An increase in the average price level of all products in an economy.

Example 1. **2018** **2019**

- Bread = $3.00 $3.05
- Automobiles= $20,000 $21,000
- Wages = $16.00/Hour $ 16.31/Hour

2% is considered normal

When inflation occurs, each dollar of income will buy fewer goods than before

Good or Bad?

- In general, ramped inflation is bad because banks don't lend and people don't save.
- This decreases investment and GDP.

What about deflation?

Deflation- Decrease in general prices or a negative inflation rate. Deflation is bad because people will hoard money (financial assets)

This decreases consumer spending and GDP.

Disinflation- Prices increasing at slower rates

How is inflation measured?

There are two ways to look at inflation over time:

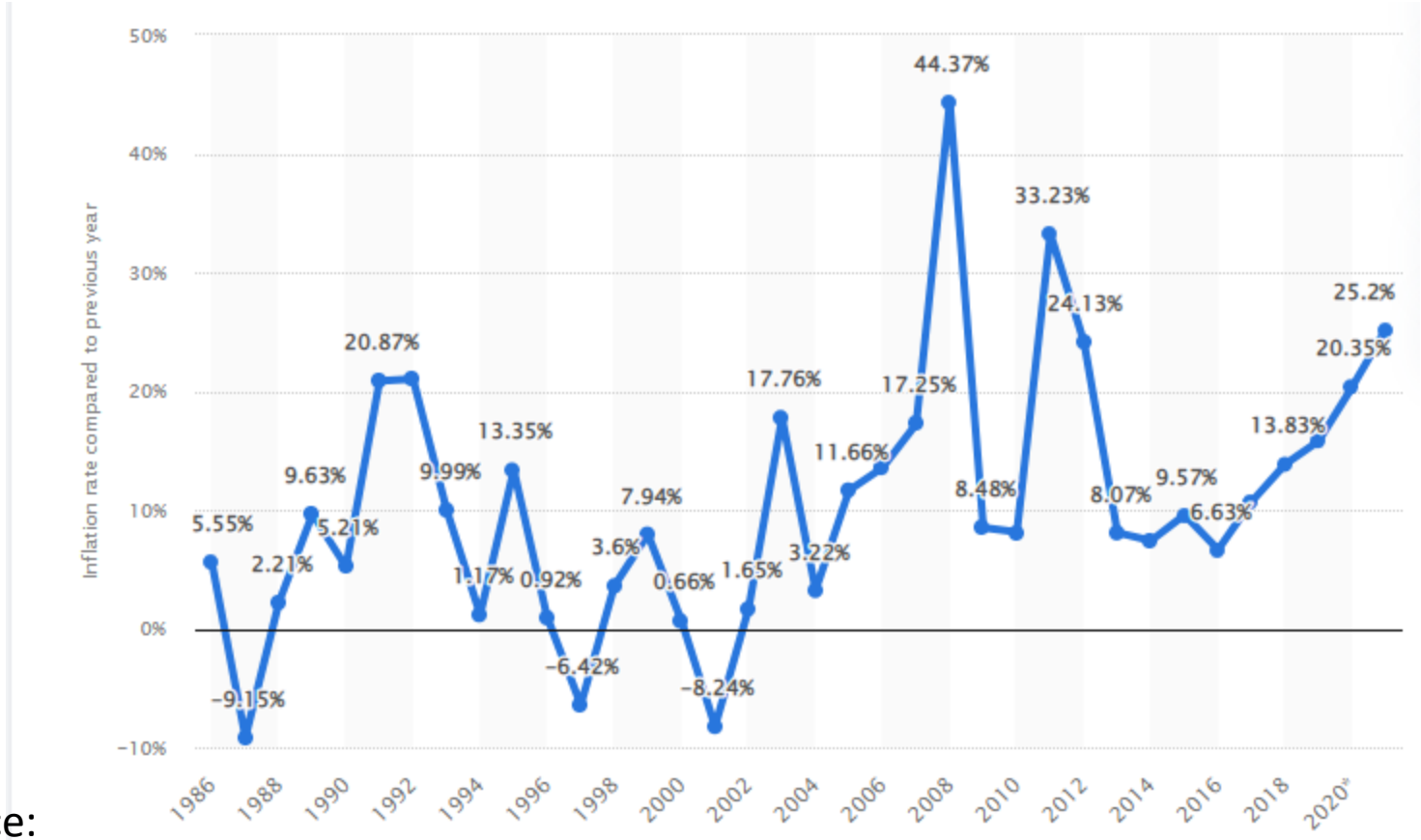
The Inflation Rate- The percent change in prices from year to year

Price Indices- Index numbers assigned to each year that show how prices have changed relative to a specific base year. is a measure of the average change over time in the prices of goods and services bought by producers.

Example 2:

- The U.S. inflation rate in 2014 was 0.8%.
- The Consumer Price Index for 2014 was 235 (base year 1982). This means that prices have increased 135% since 1982.

Ethiopia: Inflation rate from 1986 to 2021



Source: https://www.statista.com/statistics/455089/inflation-rate-in-ethiopia/

Causes of Inflation

- **Changes in Aggregate Demand**— changes in the total amount of spending by individuals and businesses throughout the economy.
- **Changes in Aggregate Supply**— changes in the total amount of goods and services produced throughout the economy.
- **Growth of the Money Supply.**
- As more dollars enter the money supply the value of dollar or it's purchasing power (the amount it can buy) is less. So to keep prices "stable", the money supply should increase at the same rate as the economy is growing.

Effects of Inflation

<u>Inflation causes changes in</u>:

- The purchasing power of the $
- The value of real wages
- Interest rates
- Saving and investing
- Production costs

Bringing Past Costs to the Present: Adjusting for Inflation

- **Inflation adjustment** or **deflation** is the process of removing the effect of price inflation from data. It makes sense to adjust only data that is currency denominated in this way.
- Inflation is a persistent and appreciable increase in the general price level that occurs over time
- Inflation decreases the purchasing power of each unit of money

– therefore, to make costs from different past years comparable, we have to standardize all costs to the same base year

- If retrospective data are used to assess resources used over a number of years back, these costs should be adjusted, or valued at one point in time

- inflation is usually measured by the consumer price index (CPI), which describes the prices in a given period as a percentage of prices in a base period

Adjusted cost = C_t*****CPI_t

where, Ct = nominal cost for selected year, CPI_t = consumer price index of selected year

$CPI_t = (1+\%Inflation)$

Adjusted cost = Ct*(inflation rate+1)

- Example 3: Which of the following two projects is less costly, if the consumer price index (CPI) inflation rate for 2019 was 22.5%?

Project	**Cost Estimate ($)**	**Year of Cost Estimate**
A	150,000	2018
B	152,000	2019

- for uniform comparison of costs of the two projects, 2018 costs should be adjusted to their 2019 value.

Adjusted cost = Ct*(inflation rate+1)

= 150,000(0.225+1) = 183,750

2019 value of $150,000 is **$183,750 which is higher than $152,000.**

Therefore, project A is more costly

- Example 4: Based on the following costs from a *retrospective* analysis, What is the 2019 value of the total cost of the intervention? use medical consumer price index inflation rate for 2018 = 3.5% and for 2019 = 4%?

Year of cost estimate	**2017**	**2018**	**2019**
Intervention costs	10,000	20,000	30,000

Since the costs are collected at different years, they should be adjusted, or valued at one point in time before adding together.

Adjusted 2017 cost = 10,000 x 1.035 x 1.04 = 10,764

Adjusted 2018 cost = 20,000 x 1.04 = 20,800

Then total cost = 10,764 + 20,800 + 30,000 = <u>61,564</u>

- Example 5 (Assignment):

Based on the following costs from a *retrospective* analysis, what is the 2019 value for the three alternatives using a medical consumer price index (MCPI) inflation rate of 3.5% per year?

Year	**2017**	**2018**	**2019**
Intervention costs	10,000	20,000	30,000
Alternative 2 costs	15,000	25,000	35,000
Alternative 3 costs	20,000	40,000	45,000

End of Chapter Four